Optical Time Variability of Fermi Blazars in Kepler Field 0

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This proposal has two goals:
1) Characterize the optical variability of synchrotron emission from the relativistic jets in γ-ray blazars, which informs us about the nature of turbulence in these jets.
2) Determine if the accretion disks of γ-ray -emitting, radio-loud quasars produce different optical emission from those of non-γ-ray-emitting, radio-quiet quasars, which implies that the accretion disks play an integral role in the process that makes radio-loud quasars different from radio-quiet quasars.

Starting in March 2014, we propose to obtain optical light curves of ~5 Fermi γ-ray blazars and 4 radio-quiet quasars with 30-minute integrations obtained continuously for ~ 80 days. Blazars vary 2-5 magnitudes. γ-ray blazars are the most extreme members of the blazar class, including flat spectrum radio quasars (FSRQs) and BL Lac objects. We will measure the power spectral densities (PSDs) of the light curves, which are characterized by power law slopes; characteristic timescales can be identified where breaks are seen. We will evaluate the γ-ray activity level and variability using Fermi LAT data (a Fermi proposal has been submitted). Target of Opportunity Swift data during the K2 Field 0 campaign will delineate the relative contributions of synchrotron jet and thermal accretion disk emission. The combined precision and frequent time-sampling of the optical light curves will be the best ever obtained for γ-ray blazars.

For the "Field 0 Campaign", we are submitting a target list of 5 γ-ray blazars including the bright Fermi blazar PKS 0722+145 and the Fermi-Veritas TeV blazar J0648+152 and 4 radio-quiet quasars. These are the optically brightest γ-ray blazars in the 12° radius of Campaign 0's field center. Our blazar and radio quiet quasar targets have V-equivalent magnitudes brighter than ~17.6.

Previous Kepler Studies of FSRQs and BL Lacs: We used Kepler to monitor 3 FSRQs nearly continuously over three years (Figure 1a, Wehrle et al. 2013; Revalski et al. 2014). The original Kepler field contained no γ-ray blazars. We found that the FSRQs' PSDs had power law slopes of -1.8 to -1.2 ("red noise") on long timescales, and white noise on short timescales, consistent with turbulence in the optical jet or in the accretion disks (Figure 2). Edelson et al. (2013) obtained Kepler observations of only one (non-γ-ray) BL Lac object (Figure 1b) whose PSD was bent from -2.3 to -1.1. We achieved 0.9% precision for a V=18.4 AGN in our previous observations. K2 should achieve similar precision on brighter V~17.5 AGN.

Edelson, R. et al. 2013, ApJ, 766, 16.
Revalski, M., Nowak, D., Wiita, P., Wehrle, A., & Unwin, S. 2014, submitted to ApJ , arXiv 1311.4838
Wehrle, A., et al., 2013, ApJ, 773, 89.

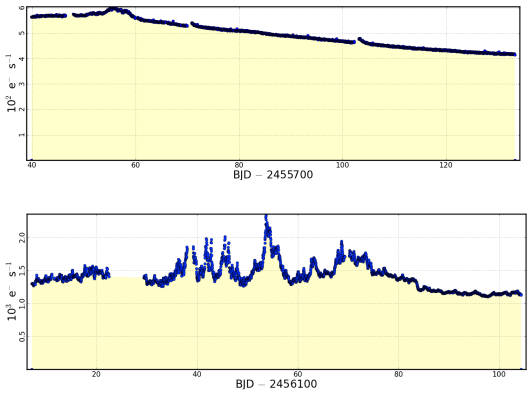

Figure 1a (top). 90-day Kepler light curve of FSRQ 1918+4937. **Figure 1b** (bottom). 90-day Kepler light curve of BL Lac object W2R 1926+42.

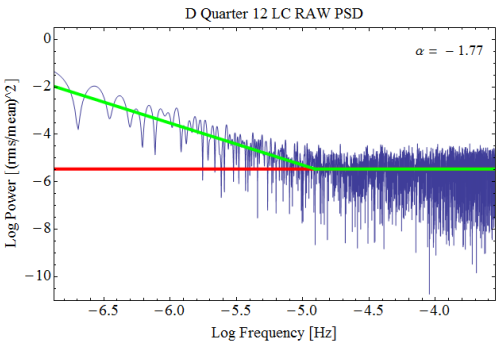

Figure 2. Power Spectral Density of 90-day Kepler observation of FSRQ 1924+507 has a "red noise" power law slope of -1.77 on long timescales and white noise on short timescales.